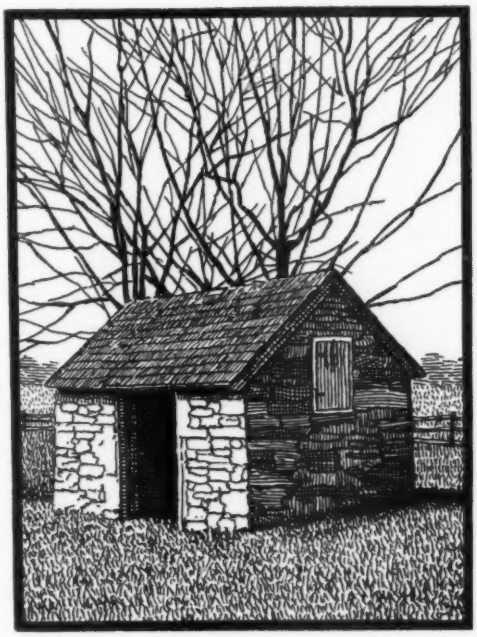
ARBORETUM BULLETIN
OF THE
ASSOCIATES

JULY, 1939



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Cedar of Lebanon
Cedrus libanotica, Link.

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The frontispiece of this number represents a specimen of the Cedar of Lebanon, *Cedrus libanotica*, Link, growing near Hillcrest Avenue at the Morris Arboretum. This tree belongs to the flora of Asia Minor and Syria, where it grows as an upright or somewhat spreading tree, with dark-green leaves. Its cones are from four to five inches across, brown in color, with scales about 5 c.c. wide. It is hardy up to southern New England, and exhibits many horticultural variations. It was introduced into this country in 1680 (Rehder), and has a special interest because of its scriptural associations.

The cover illustration represents the old stone "BLACKSMITH SHOP" near the Mill on the Wissahickon.

The photograph and the drawing were made by Gustave Liebscher.

HEDGES*

—BY—

MR. HARRY WOOD, *Superintendent*

Arthur Hoyt Foundation, Swarthmore College

History

INTEREST IN GARDENING, particularly in ornamental horticulture, has increased tremendously in America during the last twenty years, due no doubt to the growth of the garden clubs. Unusual plants of every description and great beauty have been introduced to American gardens. The desire to own a home in the country or suburbs has been instrumental in creating enthusiasm in gardening. Every new home, no matter how small, has been planted in some manner, perhaps not always to the best interest of the surroundings, but nevertheless an effort has been made to improve the property. To this new interest may be attributed the demand for new and better hedge materials. Although the use of hedges is not new, comparatively few species have been used for this purpose.

A hedge is a living green fence designed for protection or ornament as well as a thing of beauty, changing with the seasons of the year, with different color hues and bloom. Hedges have been used by farmers in England for hundreds of years, as a protection against encroachment by stock over their land. The prosperous farmer uses the method of crop rotation. Generally, once in five years he plows his lea field (sod) which is usually enclosed by a hawthorn hedge, planted on a mound of earth about three feet high. Before plowing the field the hedge is felled. By this I mean the upright branches are cut part way through and laid down and woven in (the cut in the branches is generally made about 2½ ft. from the base). Along the hedge all surplus wood is cut out. When growth starts, the young shoots break from the lateral buds, which grow up in a vertical position, thus forming a new hedge. During that year not much attention will be needed except for an occasional slashing to keep any vigorous new growth under control. The following year the hedge is slashed on each side with a long hook. This method is continued each year until it is time to fell again. It will be readily seen that this is not a very expensive method, but the result is an almost impregnable hedge which is a thing of beauty. Probably the most widely used hedge plants on the farms of early American settlers were the Honey Locust and Osage Orange. The Osage Orange is still used extensively, but its unfortunate susceptibility to San Jose scale has reduced its popularity of late. The English and some of the native hawthorns have been used without great success. The advent of the wire fence no doubt brought about the abandonment of hedges as a protective fence in this country.

With the development of the large estates in England, the hedge was used to emphasize garden design, as a screen, and to give a foundation for topiary work. The yew and boxwood were used much more extensively than any other plant. The advantage of these plants was their adaptability to almost any situation. They could be trimmed to any design, as is in evidence today in the old hedges that have been in use for a couple of hundred years. The desire for privacy even in the small cottage

*Lecture given at the Morris Arboretum on February 11, 1939.

garden was unquestionably the reason for such universal use of the hedge.

In most parts of the world, man's selfish nature disposes him to fence out the intruder. However, hedges have many other qualities for which they can be recommended. Used intelligently, hedges make the landscape more attractive, provide shelter for more tender plants in the garden, enable the home owner to screen objectionable views from his garden, serve as a line of division between service yard and formal garden, prevent persons from cutting across corner lots, and stop animals from overrunning the property.

Planting and Care of Hedges

Deciduous plants are in best condition for transplanting when dormant. In this way they can be planted with bare roots. If the ground is in good condition this can be done as early as March 15th to April 30th. Species that commence growth early in Spring, Lilacs for example, should be planted in the Fall. In this district, planting of deciduous shrubs may be done until Thanksgiving.

The planting of evergreen hedges should be completed about October 15th, thus allowing them sufficient time to make some root growth before severe weather sets in. Planting of evergreens can be continued all winter, but the best time to do the job is from April 1st to May 10th, and September 1st to October 15th. Evergreens must always be planted with a ball of earth.

Hedges should be planted in well-drained soil and in a sunny location. Planting in the shade, except for a few species, is one of the chief reasons for a straggly appearance.

Hedges should be given plenty of room for development. This fact should be taken into consideration when planting a hedge on a property line, border or walk. The distance between the plants must necessarily be governed by the size of the plant used. This may vary from 12 inches for barberry or privet to 36 inches for the more expensive evergreens. The *ground* in which the hedge is to be planted should be thoroughly *prepared*. Presumably the hedge is expected to stay in the location a good many years. Therefore, do not be too economical in the use of good manures. The ground should be trenched at least two feet deep. The width should be governed by the type of hedge to be planted. A large hedge will need a prepared area at least four feet wide, a smaller hedge about 18″ to 2′. The manure should be well mixed with the soil during the trenching operation. Before planting it is advisable to allow the ground to settle. In planting a deciduous hedge, dig a trench allowing sufficient room to spread out the roots, fill in the soil, shaking it around the roots and firm well. When the operation is completed the soil should be about an inch below the level of the existing grade. After watering, a mulch of well-rotted manure should be applied, thus preventing evaporation.

Deciduous hedges should be cut back almost to the ground after planting. Plants treated in this manner will form a compact hedge from the beginning.

Care after planting is of great importance. During the first Summer after planting, particular attention should be given to watering. Should the hedge show evidence of the need of fertilizer, an application of well-rotted manure, dug under the surface, or a complete fertilizer may be applied. A hedge that is growing under the right conditions both as to soil and location, should not need any fertilizing for some years.

It will also be necessary to keep a sharp lookout for *pests* that prey on hedge plants—such as scale, red spider, bagworms, etc. These can all be controlled quite easily and inexpensively if the right precautions are taken, spraying at the proper time and with the right materials.

Most deciduous hedges require trimming but once a year, except California privet and Osage Orange, which need to be trimmed more frequently.

Pruning shears are preferable to hedge shears for many plants, particularly those with broad foliage. It is a more costly operation, as hedge shears would do the job so much more quickly but unfortunately the foliage would be marred as many of the fine leaves would be cut into small pieces, thus spoiling the real beauty of the hedge. On a hedge of Forsythia, Lilac or Spiræa, all or most of the blooming wood will be sacrificed if cut to any rigid shape. This type of hedge plant is best treated as naturally as possible, planted in a position where severe trimming is not required and trimmed only after blooming, removing the old stems. Treated in this way they will give great satisfaction as a hedge and blooming shrub. A Barberry hedge trimmed to a formal shape will be minus its beauty, as all the fruit will more than likely be destroyed.

Trimming evergreen hedges will depend upon the type used, and the kind of hedge desired. Some evergreens need more attention than others. For instance, Arbor vitae will not need as much trimming as Hemlock. The time to trim an evergreen hedge is a debatable question. The Hemlock for instance, is often trimmed in the early Fall. My preference is to trim in the Spring before the new growth starts. This method allows the current years growth to remain all year and give a very graceful appearance to the hedge. Fall trimming does the opposite, removing the new growth and the result is a very formal appearance. The Yews require much the same treatment as the Hemlocks. The more informal evergreens such as Arbor vitae and Japanese Holly, do not need as much trimming to keep them in shape.

Of course the problem of how hedges should be trimmed depends entirely on what is required. If a hedge is to be kept to a small size, naturally it must be trimmed more severely. The question is often asked how much to cut off. This also depends on the hedge, but a general rule is to cut to within one half inch to an inch of the old growth, on the hedge that is full grown. On a newly-planted hedge the amount of cutting will be determined by how fast the hedge is needed to get to desired height. It is poor practice to leave too much young growth, as the result will be a very poor, straggly hedge.

The shape and style of hedges are matters of taste, but one recognized rule is of great importance. The base of the hedge should always be wider than the top, to allow sunlight and air to reach the lower branches and encourage a strong growth from the base of the plant.

The type of hedge plant to be used will depend on what kind of hedge is needed, whether it is to be a screen, or a formal hedge, or whether tall or short. Tests of hedge suitability have been made on many plants. In order to choose from a large number of possible hedge plants a study should be made of the location which is to be developed. Of course all types of hedge plants will lend themselves to formal trimming, but on many of the finer flowering kinds bloom will be lost. Today the proper material can be had for any kind of a hedge, be it tall, medium or low, formal or informal.

HEDGES*

—BY—

R. W. OLIVER

Central Experimental Farm, Ottawa, Canada

WHILE THE COLLECTION of hedges at the Central Experimental Farm at Ottawa is no longer the largest, we feel confident in saying that it had that honour up until a few years ago, and that more different plants have been tried there than anywhere else on the continent. Since the first sample hedges were planted in 1889, one hundred and sixty different species or varieties of plant material have been tested.

After fifty years of such work, we feel confident in recommending a few of the plants which have proved most satisfactory, and are cutting down on our collections to a considerable extent. The collection at Ottawa now contains only sixty hedges, most of them comprised of material which has proved most satisfactory, and which we wish to maintain as a demonstration. A list of excellent species that have been found superior at Ottawa closes this paper.

Among the new introductions still in the experimental stage, we might mention two or three of particular interest: The Truehedge Columnberry *(Berberis Thunbergi pluriflora erecta)* which forms with us an excellent low hedge, particularly for edging, and two sorts with fine foliage hardy on the western prairies—*Prinsepia sinensis* and *Malus transitoria*. The latter has particularly attractive foliage.

The Place of Hedges in the Landscape

Hedges should be to a garden what walls and partitions are to a house. They should give us privacy from without, act as a background to the brighter displays of the garden from within, and separate one garden room from another. Because they are barrier, we require dense and frequently thorny growth and sufficient height to give the feeling, if not the actuality, of privacy. Also, they must fulfill their purpose as a barrier by always ending at a boundary or definite object, around which we cannot see or walk.

The height, colour and texture of a hedge will be governed largely by the size of the property and type of garden which the hedge surrounds. A large garden needs a taller hedge than a small garden. A tall or medium hedge should under ordinary circumstances be mid or dark green in colour, as its purpose is to act as a background to the garden. A golden, gray or red-leaved hedge is too conspicuous under average conditions, and kills the appearance of any plants in the foreground.

Low hedges or borders, which are used only to give emphasis to the design by extending the architectural lines in plan on the property, may be of brighter shades, particularly in formal work or in conjunction with light-coloured buildings of "Functional" design.

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*Abstract of lecture given at the Morris Arboretum on March 11, 1939.

The texture or detail of a hedge is largely a matter of coarse and fine foliage and the degree of shininess. Large leaves and shiny ones are seen in more detail than small or dull green ones. Consequently, they have the appearance of being nearer at hand and the tendency is to reduce the apparent size of the space surrounded by such a hedge. A hedge of fine texture and dull green colour, such as *Caragana,* would on the other hand increase the apparent size.

Now as to the practical side of bringing up the hedge in the way it should go:

Soil Preparation, Planting

The soil should always be carefully prepared for a new hedge by digging out a trench about eighteen inches deep, and at least twice as wide as the spread of the roots of the young plants. A liberal dressing of well-rotted manure should be dug into the bottom of this trench and covered with a few inches of well-pulverized sandy or clay loam top soil. When the plants are put in place more of this good top soil is put around the roots and firmly tramped down before being watered liberally.

The plants should be placed in a single row, rather than in a double row with the plants staggered, as has sometimes been recommended. The latter method uses more plants and more space, is harder to trim into a good shape, and always leaves a poor end at a gate or path where any unevenness is noticed.

Spacing

The distance apart at which the plants should be placed will vary with the material used and the height to which we wish the hedge to grow. Erect-growing shrubs like privet and the Truehedge Columnberry, used in a low hedge, should be placed nine inches to one foot apart. More bushy plants, which are to make a taller hedge, will be placed from fifteen inches to two feet apart, but for average purposes eighteen inches apart has proved most satisfactory.

Time to Plant

Deciduous hedges should be planted in the fall as the leaves are about to fall, or in the early spring before the leaf buds burst. Evergreens are planted in September, or just before new growth starts in the spring.

Size of Plant

It is better to use fairly small plants unless one can procure larger ones which have been frequently cut back to make them bushy. Two-year-old plants from seed are excellent for most deciduous hedges and four years for conifers. The first spring after planting, deciduous hedges should be cut down to within a few inches of the ground. If older bushy plants are used, cut them back almost to the base of last year's growth. This causes the plant to throw out numerous new shoots close to the ground. In the case of conifers, cut off only about half of last year's growth. Conifers do not usually put out new buds and foliage from bare wood, and consequently will not stand heavy cutting back.

Trimming

Hedges must be clipped each year to keep them in good shape. Never let a hedge reach the desired height before starting to trim it. This will result in a bushy top on tall leafless stems. A hedge must be built from the ground up, not from the top down.

Time to Trim

The correct time to trim will vary with the locality and the season. In general, hedges should be trimmed when the active period of new growth is about at an end. In the northern states this will be at the end of June or early July for deciduous plants and about September first for conifers. If possible, hedges should be clipped during cool, dull spells of weather as this will avoid tip-burning to a great extent.

The reason for clipping toward the end of the growing season is largely one of economy. Hedges trimmed at this time rarely grow enough to get out of shape during the remainder of the season, and will look untidy for only two or three weeks in June. Spring-trimmed hedges or ones trimmed in late fall will need a second trimming to prevent them from looking shaggy all summer.

Shape

The shape to which a hedge is trimmed has a cultural as well as an aesthetic value. From long experience in our northern climate, hedges should be trimmed so that they are slightly wider at the bottom, which permits more light to reach the lower foliage, and consequently helps to keep the hedge close to the ground. Hedges which are widest at the top or which have perpendicular sides do not retain their lower foliage so well. Flat-topped hedges become laden with snow in winter and frequently broken down, so that a rounded or pointed top is best in districts where the snow fall is heavy.

Fertilizing

Because we desire thick, vigorous growth, fertilizing is advisable. We cannot say it is necessary, because even hedges which receive no treatment other than a very occasional application of barnyard manure still continue to hold their foliage. Yet, proper diet pays here as anywhere else. Where it can be obtained, a top dressing of well-rotted barnyard manure applied in the fall and lightly forked into the surface soil in the spring is quite satisfactory. The application of chemical fertilizer by means of the punch-hole method, as in feeding trees, is also good, and the fertilizer will of course vary with the soil. Hedges require high potash as well as nitrogen to form stocky growth of good colour. Coniferous hedges prefer nitrogen in organic form such as blood meal.

Selecting Material

In selecting material for a hedge, several points must be considered. Many of them will be determined by personal taste; such as, whether we wish to have an evergreen or a deciduous hedge, shiny or dull foliage, coarse or fine texture. Rate of

growth, type of soil and degree of shade or sunshine, moisture or drought, are also to be considered. Last, but not least, is the freedom from diseases and insects. Lilac hedges, for instance, are very subject to mildew, which spoils their appearance. Hawthornes suffer from the ravages of all insects which attack the apple, and may consequently prove a source of infestation in a fruit district. Neither of these hedges, although both are useful, should be planted unless they can be properly sprayed.

Best Hedges

The following hedges have proved most satisfactory at Ottawa, and can be thoroughly recommended wherever they are hardy:

Conifers

White Spruce *(Picea glauca)*
White Pine *(Pinus Strobus)*
Japanese Yew *(Taxus cuspidata)*
Hemlock *(Tsuga canadensis)*
Douglas Fir *(Pseudotsuga taxifolia)*
Arborvitae *(Thuja occidentalis)*
Swiss Stone Pine *(Pinus cembra)*

Deciduous, Non-Flowering

Dwarf Barberry *(Berberis Thunbergii)* & vars.
Canoe Birch *(Betula populifolia)*
Siberian Pea *(Caragana arborescens)*
Hawthorne *(Crataegus species)*
Amur Privet *(Ligustrum amurense)*
Bush Honeysuckle *(Lonicera tatarica)*
Common Lilac *(Syringa vulgaris)*
Hungarian Lilac *(Syringa Josikea)*
Chinese Elm *(Ulmus pumila)*
Wayfaring Tree *(Viburnum lantana)*
Beech *(Fagus grandifolia)*
European Larch *(Larix decidua)*
Shingle Oak *(Quercus imbricaria)*
Buckthorn *(Rhamnus frangula)*
Laurel Willow *(Salix pentandra)*
Dwarf Siberian Pea *(Caragana pygmaea)*

CULTIVATION OF HARDY FERNS*

— BY —
MRS. A. C. BARNES
Director of the Barnes Arboretum, Merion, Pa.

FERNS GO BACK to the Paleozoic era, fifty-three or more million years ago, and are older than any form of terrestrial vegetation now in existence, as other forms have either ceased to exist or are now so modified as not to be easily identified. They were the all-embracing form of vegetation at one time and formed the base of our coal-deposits, fossil remains of which are often found, proving that they have remained true to form.

Ferns are the third and highest division of flowerless plants in the kingdom, are known as the Pteridophytes, and are made up of twelve families, including the exotic and tropical. These vary in size from hair-like creeping stems and moss-like leaves, to

*Abstract of lecture given at the Morris Arboretum on April 15, 1939.

tall trees eighty or more feet high, and there is no country or region where ferns do not grow, except in absolute desert. There are 6,000 species known to science; 250 species in America and northern Mexico; 75 native American species; about 150 hardy species, with 60 species in cultivation.

Ferns are of little economic importance except as ornamental plants, although they do do good in breaking down rock formation to form soil, and also on banks where they hold soil in place, not permitting it to be worn away by water. The starchy rootstocks of some species are eaten locally, as are also young shoots, while a few others are used medicinally. Certain species are of use to florists and horticulturists, and without them the world would lack much of beauty. Thoreau said: "Nature made a fern for pure leaves," and although to many a "fern is just a fern," the many species and varieties, with their differences in color and texture, give us pleasure and enjoyment.

Like other members of this *phylum,* they reproduce by means of spores, runners, or in some instances buds or bulblets, and also tips of the leaves, and it is interesting to note that the method of reproduction was discovered only in the first half of the nineteenth century. Some species, perhaps the majority, prefer an acid soil, but some have a predilection for limestone, growing in crevices or on ledges, while still others prefer granite or sandstone.

For planting purposes ferns may be divided into two classes, the first those having slender branching rootstocks which creep at or just below the surface. These ferns spread rapidly and make large, dense colonies; for example, *Dennstaedtia puntilobula,* the Boulder Fern, or called by some the Hayscented Fern. This fern prefers dry, rocky fields and makes a rather tangled clump. Another fern in this class, *Pteris aquilina or Bracken,* spreads rapidly and is hard to eradicate and grows so tall —three to four feet—that it oftens smothers the surrounding planting.

New York Fern, *Dryopteris novaboracensis,* is another fern in this class, but prefers shady, dry places; while still another, *Dryopteris thelypteris* or Marsh Fern, prefers moist, shady places. By moist soil is meant a well-drained soil, not dry, and not one that is marshy or constantly wet. These ferns, and other ferns with running roots, send up fronds a few inches apart all through the growing season. Therefore, they can be transplanted at any time, and should be planted with the roots not more than one inch below the surface.

The second class of ferns, those with thick rootstocks, bear one set of fronds a season in more or less circular tufts rising from the crown only, so that in planting it is necessary to place the rootstock upright and not to bury the crowns, but to plant them just above the surface of the soil, and in every case with the roots spread out in their natural position. All these ferns should be planted far enough apart, so that beauty of foliage and luxuriance of growth may be secured.

Perhaps the best-known ferns in this class are the Osmundas, called the Flowering Ferns, because they have the sporangia at apex or middle of the frond or as a

separate leaf—a sporophyll. These are all tall ferns, which is a point to be considered in planting:

Osmunda claytoniana, Interrupted fern which grows in sun or shade.
Osmunda regalis, Regal or Flowering fern, which prefers a cool, moist situation.
Osmunda cinnamomea, Cinnamon Fern. This will grow in sun or shade and in a fairly dry location.

Another tall fern, *Pteritis nodulosa* or Ostrich Fern, is not particular as to location, but does not last through the summer, as it withers and turns brown by the first of August.

The lasting quality of a fern is also a point to be considered, and another fern that does not last through the season is *Cystopteris fragilis,* one of the Bladder Ferns, but it is dainty and attractive while it lasts. In contrast to it, another Bladder Fern, *Cystopteris bulbifera,* lasts until cut down by frost, and grows in moist or dry locations, in sun or shade. This fern, although it bears spores as freely as any other, also has tiny bulblets in the axils of the pinnules, which, when they come in contact with the soil, put forth roots and are ready to begin life for themselves.

Some ferns are evergreen, e.g., the Christmas Fern, *Polystichum acrostichoides,* used by florists, which has a dark green, leathery texture, and prefers a northern sloping bank.

Polystichum munitum—a native of the west.

Polystichum brauni—Braun's Holly Fern—while not actually evergreen, does last well on in the season, when the rachis bends down from the weight of the rather heavy hairy fronds.

Polystichum aculeatum—similar but smaller than the above.

Dryopteris marginalis—Marginal Fern—easy to grow and delights to nestle among crevices in the rocks.

The *Lastraeae—chrysoloba* and *opaca*—not as well known here as abroad, and others in this species, which with us have proved evergreen or almost so.

Another genus, the *Athyriums,* are easy to grow and one known all over the world is the Lady Fern, *Athyrium filix-foemina,* and, with another which resembles it very closely, *Athyrium angustum,* will grow in sun or shade, moist or dry situations. *Athyrium thelypteroides,* the Silvery Spleenwort, is heavier in texture, but grows under any condition, in contrast to *Athyrium pycnocarpon,* Narrow-leaved Spleenwort, which has long, narrow leaves, easily broken down by summer storms, and prefers moist shade, but its dark green fronds are a good contrast to ferns of a lighter color.

In the wood ferns, or genus *Dryopteris,* which prefer shade, there are many of different textures and tones:

Dryopteris filix-mas—Male Fern—grows erect, as does:

Dryopteris cristata—Crested Fern,

Dryopteris spinulosa—Spinulose Shield-Fern, which has finely divided foliage.

Dryopteris bootti, is now classed as a hybrid of the two last mentioned. In the nomenclature of the ferns there has been a great confusion of terms, for besides the common names given in the localities in which they have been found, the botanists have changed the scientific names from one genus to another, and changed the names of the species and varieties as well.

Another *Dryopteris, goldiana* or Goldie's Fern, grows four or more feet high, and is equally attractive either as a specimen or in a mass.

Dryopteris viridescens, a native of China and Japan, is most dainty and attractive.

Lygodium palmatum, the Climbing Fern, as well as *Camptosorus rhizophyllus,* the Walking Fern, are among the eighty-nine species and varieties which we are able to grow in normal wood habitat in these parts.

There is no difficulty in growing ferns if care is taken to consider their individual likings as to sun or shade, moist or dry situations, etc. In an order so varied in form and texture there are many standards of beauty, some ferns being at their best when grown as specimens, others when seen in masses. The setting and surrounding planting must be considered, as all ferns require a mulch, about two inches in summer and four inches in winter, and in every case, the roots, and not the plant itself, must be covered, as the fronds, especially in the root-creeping species, form sufficient protection. Ferns should not be planted in a perennial border, as they cannot be cultivated, but this does not mean that flowering plants cannot be associated with them, for many of our woodland plants, from the time of the first blood-root, anemones, primroses, etc., to the fall-blooming asters and cardinal flowers, give us a succession of bright and contrasting colors. Of course, rhododendron, laurel, and our native azaleas, must not be forgotten, as, with the trees, they furnish shade and also add the beauty of their blossoms.

ARBORETUM OF THE BARNES FOUNDATION—*List of Ferns Illustrated*

Dennstaedtia punctilobula—Boulder Fern
Osmunda claytoniana—Interrupted Fern
Osmunda regalis—Regal Fern
Osmunda cinnamonea—Cinnamon Fern
Pteritis nodulosa—Ostrich Fern
Cystopteris fragilis—Common Bladder Fern
Cystopteris bulbifera—Bulb-Bearing Bladder Fern
Polystichum acrostichoides—Christmas Fern
Polystichum munitum
Polystichum brauni—Braun's Holly Fern
Polystichum aculeatum
Dryopteris marginalis—Marginal Fern
Lastraea opaca
Lastraea chrysoloba
Athyrium filix-femina—Lady Fern
Athyrium thelypteroides—Silvery Spleen-wort
Athyrium angustum
Athyrium pycnocarpon—Narrow-leaved Spleen-wort
Dryopteris cristata—Crested Fern
Dryopteris spinulosa—Spinulose Shield-Fern
Dryopteris bootti
Dryopteris goldiana—Goldie's Fern
Dryopteris viridescens
Onoclea sensibilis—Sensitive Fern
Dryopteris hexagonoptera—Beech Fern
Lygodium palmatum—Climbing Fern
Camptosorus rhizophyllum—Walking Fern
Dryopteris filix-mas grandiceps drevery

TREES AS ENERGY TRANSFORMERS

I SUPPOSE that to most of us who have a fireplace and a woodpile, it is a routine matter when the room is a little chilly and darkness comes on, to start a fire and enjoy the light and heat given off by the burning wood. Perhaps we do not appreciate what we have really done in carrying out this simple program—how deeply we have reached into the affairs of the universe. Let us consider what has taken place.

The sticks of wood were once part of a living organism—a tree—that, like us, needed energy to run its machinery. The ultimate source of energy for us is the sun that from its fiery surface radiates light and heat into space. This radiant energy penetrating our atmosphere supplies this most urgent need felt by all living things. The tree, like other green plants, throughout its life absorbs this energy through its leaves, and by using the green material, chlorophyll, is able to build up its body. The roots absorb from the soil a small quantity of several kinds of minerals dissolved in water, and the leaves absorb carbon dioxide gas from the air.

From these simple and rather stable substances, the living protoplasm is able through the properties of the chlorophyll to use the energy coming from the sun, to break up the molecules of water and carbon dioxide, and to rearrange the resulting materials to form chemical substances in which a part of the sun energy is tied up as potential chemical energy. The body of the tree, increasing in size from year to year as the growth processes continue, becomes the massive trunk and branches that the woodsman cuts down. This woody mass of cellulose has been a storehouse in which an increasing amount of potential energy is put away year by year, to rest in peace until liberated by some suitable agency. Like the beds of coal lying for millions of years in the earth, it holds its captive sunshine.

When we started a fire in the fireplace and reached for the sticks of wood, we again started to dabble in the affairs of the universe. We strike a match, and by so doing turn the chemical energy stored in the match head into heat and light. This is applied to the kindling in the fireplace, which catches the blaze, and in turn heats up the sticks we had laid upon it. Soon the fireplace begins to resemble in an infinitesimal way a part of the sun's surface, giving off light and heat. The energy from the sun that had been caught and held as chemical energy in the wood now is being freed after years in storage.

The fire probably proceeds to its usual end. The gases given off from the heated wood burn for a time as luminous flames. The hot coals glow, and finally only ashes remain, and that part of the story is done.

The sun energy has been freed as light and heat that radiated into space, the water went up the chimney as water vapor, and the carbon dioxide went with it

back to the atmosphere. Only the ash remained, and that probably went back to the earth.

We have had a glimpse of cosmic happenings, and have taken part in one of the commonest human experiences.

RODNEY H. TRUE

ACKNOWLEDGMENTS

The Arboretum is grateful for the following presentations:

EASTERN SHORE NURSERIES
Maryland.
20 plants of 2 species

A. E. WOHLERT
Penn Valley Nursery, Narberth, Penna.
2 plants of 2 species

HENKELS & MCCOY
Germantown, Philadelphia, Pa.
2 plants of 2 species

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Bureau,
Chapel Hill, North Carolina.
43 plants of 19 species

U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Bureau, Zanesville, Ohio.
22 plants of 11 species

ARTHUR HOYT SCOTT FOUNDATION
Swarthmore, Penna.
34 plants of 32 species

COLE NURSERY COMPANY
Painesville, Ohio.
4 plants of 1 species (*Fuchsia*)

AMBLER NURSERIES
Ambler, Penna.
21 plants of 11 species

ARBORETUM OF THE BARNES FOUNDATION
Merion, Penna.
1 plant of 1 species (*Lonicera Maximowiczii* var. *Sachalinense* F. Schmidt.)

U. S. DEPARTMENT OF AGRICULTURE
Plant Introduction Garden,
Bell Station, Maryland.
58 plants of 13 species

CHARLES F. JENKINS
Germantown, Philadelphia, Pa.
3 plants of 3 species of Hemlock

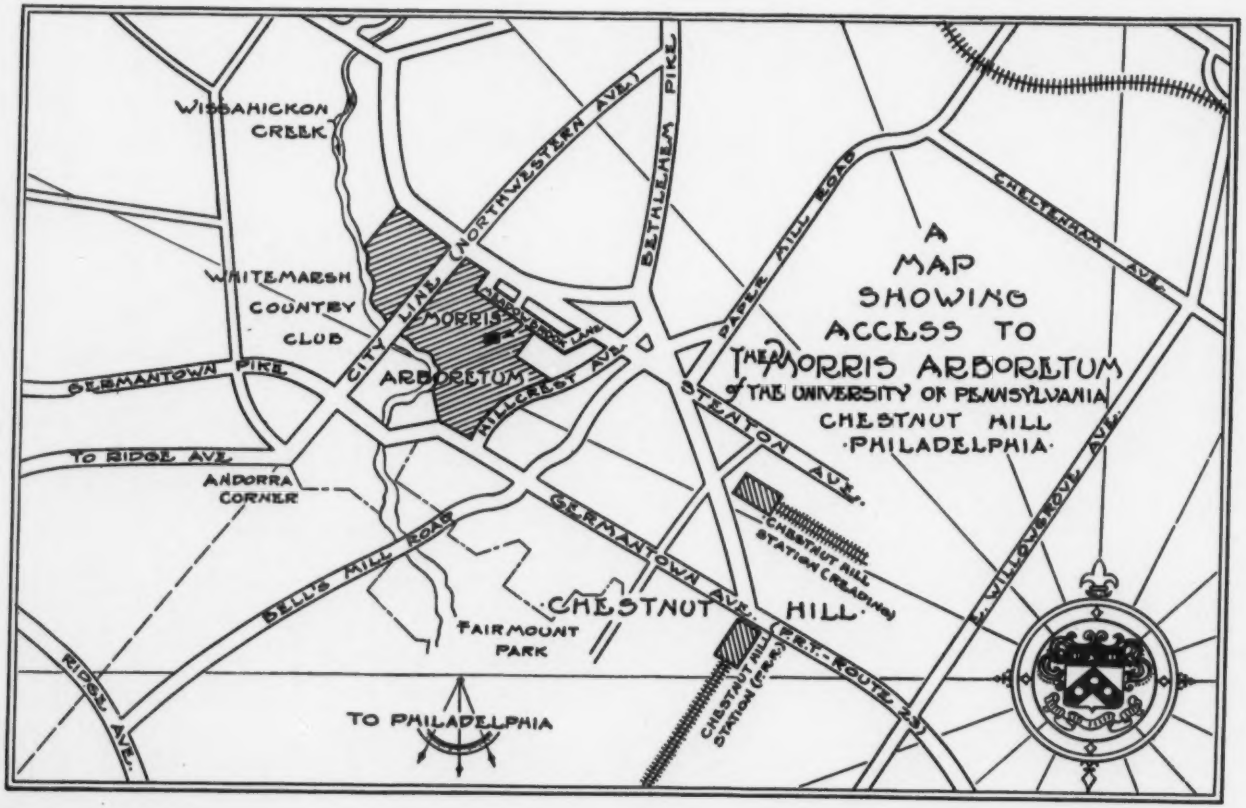
SIMPSON ESTATE, "HEARTHSTONE"
Indian Run Road, Merion, Penna.
2 plants of 1 species (Chestnuts)

MISS ALICE CRAWFORD
Fox Chase, Penna.
1 plant of *Billbergia pyramidalis*

MASONIC HOME
Elizabethtown, Penna.
41 plants of 36 species

E. M. ROSENBLUTH
Wallingford, Penna.
30 varieties of Hybrid Perpetual Roses

ROSE MANUFACTURING CO.
Philadelphia, Pa.
Supply of TRIOGEN for use in Rose Garden


A
MAP
SHOWING
ACCESS TO
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CHESTNUT HILL
PHILADELPHIA
WISSAHICKON CREEK
WHITEMARSH COUNTRY CLUB
CITY LINE
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ANDORRA CORNER
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BELL'S MILL ROAD
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FAIRMOUNT PARK
RIDGE AVE.
TO PHILADELPHIA
CHESTNUT HILL STATION (P.R.R.)
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